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JPRS-ESA-85-039

29 December 1985

EAST EUROPE REPORT

SCIENCE AND TECHNOLOGY

CONTENTS

ROMANIA

GDR-USSR COOPERATION IN CEMA STANDARDIZATION EFFORTS OUTLINED

East Berlin STANDARDISIERUNG UND QUALITAET in German Vol 31 No 5, July 1985 pp 121-122

[Article by Dr G. D. Kolmogorov, Chairman, State Committee for Standards of the USSR (GOSSTANDART)]

[Excerpts] Sixty years ago, the Committee for Standardization was founded as part of the Council for Labor and Defense of the USSR. Over the years, standardization and systems of measurement have been visibly on the rise in the USSR. Fifteen republic administrations, 37 centers for standardization and measurement, over 260 laboratories of state inspection, 16 scientific research institutes as well as 32 production plants testify to the powerful potential available to the State Committee for Standards of the USSR (Gosstandart).

A number of decisions were made based on the resolution of the Central Committee of the CPSU of August 18, 1983 concerning "Measures to Accelerate Scientific-Technical Progress in the National Economy," in recognition of the increasing importance of standardization for the national economy of the USSR as well as for the deepening of socialist economic integration.

International Standardization

Standardization has an important function in international economic, scientific and technical cooperation, especially in the enhancement of the integration of socialist economies. In recent years, it has developed in a fruitful way in CEMA, both quantitatively and with regard to its influence on the national economies of the brother countries. There are presently some 5,000 confirmed CEMA standards. According to available figures, in the national economies of PRB [People's Republic of Bulgaria], UPR [Ukrainian People's Republic], PRP [People's Republic of Poland], USSR and CSR between 71 and 80 percent of CEMA standards are utilized, with a significant economic impact.

The resolutions of the economic discussions at the highest level and of the 38th Council Meeting have paved the way for a fundamentally new developmental stage that will also effect standardization in CEMA.

An important link in the chain of joint efforts is the creation of CEMA standards for machines, equipment, and reciprocal deliveries with technical and economic standards that correspond to world levels.

Of particular importance in this regard is the CEMA resolution concerning the preparation and implementation of a unified quality evaluation and certification system for reciprocal product deliveries on the basis of CEMA standards for the member countries.

At the present time, plans and programs for the cooperation among CEMA member countries in the area of standardization are being prepared for the period 1986-1990 and for the longer term as well. We consider it essential that these documents establish a far-sighted framework by establishing in normative and technical terms the directional priorities for this cooperation and that time frames for the implementation also correspond to the scheduling of the joint measures. Special attention must be paid to acceptance of the most important values for technical and qualitative aspects of CEMA standards.

Bilateral scientific and technical cooperation in the area of standardization between the USSR and the GDR is considered extremely important. In this regard, the establishment of a normative technical framework for the effective realization of the program of specialization and cooperation in production between the USSR and the GDR until 1990, of the related programs and bilateral agreements, is of particular importance. There are currently more than 1,000 unified standards that have been confirmed by the USSR and the GDR, more than half of which establish unified technical requirements for products (including design requirements, primary parameters, measurements, etc.), as well as testing and measuring procedures for quality control of the products.

This cooperation is being further extended. Gosstandart of the USSR and the ASMW of the GDR are currently concluding the establishment of the "Major Directions in the Development of Bilateral Scientific-Technical Cooperation in the Area of Standardization as well as of the Management of Quality Control for the Time Period 1986-1990." The implementation of this program will help to speed up progress in scientific and technical areas, extend production specialization and cooperation and contribute to the development of mutually beneficial trade between our countries.

12792
CSO: 2302/108

NEW BULGARIAN TECHNOLOGIES DESCRIBED

Sofia RODOLYUBIE in Bulgarian No 9, 1985 pp 14, 15, 26, 27

[Article by Panayot Lyakov: "Invented in Bulgaria"]

[Text] Every year hundreds of inventions are created in Bulgaria, and Bulgaria is one of the 10 leading countries in the world in intensity of invention activity. These inventions include veritable masterpieces of technological thought which are transformed into unique machinery and apparatus, drugs and systems, methods, devices, and technologies. Four of them will be discussed in what follows.

The Only SD-Meter in the World

This instrument was developed at the Institute of Physical Metallurgy and Technology of Metals under the Bulgarian Academy of Sciences. Behind its strange name there is an automatic general-purpose stand by means of which the contact voltages in molding compounds are determined at extremely high speed by an original method. Bulgarian specialists had discovered a previously unknown relationship: if an ultrasonic impulse is delivered to a contact surface by a precisely determined method, the reflected signal depends on the contact voltage. But additional inventions were needed before the marvelous SD-Meter could make its appearance and be used to check complex and costly shrouded instruments. They are very easily damaged if the tension between the steel shroud band and the operating die of hard but brittle metal is not accurately determined. For the first time in world practice, it has become possible to inspect shrouded instruments nondestructively and with very high accuracy. It was previously necessary to disassemble these instruments and examine them with complex optical apparatus. Now the instrument is placed on the stand and a microcomputer begins automatic inspection in accordance with an assigned program. The computer controls the ultrasonic system, which generates and receives acoustic signals (impulses), as well as the mechanical device positioning and scanning the instrument inspected. After the data obtained have been processed, the computer analyzes them and the results are displayed on the monitor screen or are printed out in a standard document. Hence the contact voltages of various instruments can be measured simply by changing the microcomputer programs. The result of this high-quality and high-speed inspection inspection is that the cost of outfitting with instruments is lowered and the down times of high-output machines due to cracked or chipped or fractured tools are reduced.

The SD-Meter is used for research at scientific institutes, and has been introduced into the Bulgarian machinebuilding industry, yielding considerable economic effect. Interest has been expressed in it in the most advanced industrial countries of Europe and America, and the first first orders have already been placed with the Institute of Physical Metallurgy Technology of Metals.

The Predima-M Compressed-Air Spinning Machine

This is the first machine in the world for spindle-less compressed air spinning of fancy worsted yarns of wool, artificial fibers, and mixtures of the two. The Predima-M is several times better in technical and economic indicators than well-known spinning systems used throughout the world. The yarn is formed by a swirling stream of air, without the use of rotating elements, so that a high spinning speed is reached, 150 meters per minute. The spinning heads of the machine operate independently of each other, and the production process is stable, that is, there are no flaws, breaking of thread, and so forth. In addition, the process is watched by means of a number of control instruments. There is, for example, a special compensator which permits removal of flaws from the yarn without stopping the spinning process. One person operates three machines simultaneously.

The capabilities of the Predima-M are due to the method and the equipment used to produce the yarn with a core invented by the well-known Bulgarian textile specialist Milko Dimitrov, a Dimitrov Prize winner. This method and equipment were duly recognized at the autumn industrial fair in Plovdiv in 1984, when the Predima-M was awarded a gold medal and also received the Golden Hands design award. The latter was a fitting award, since the light, shaggy, and soft yarn giving a mohair and boucle effect and from which elegant articles of clothing are woven and spun in improbably rich shades of color seem to have been worked by golden hands. This is the new boom in Bulgarian textile manufacture. The Predima-M machines are already in production in Bulgaria and are yielding a major financial effect expressed in millions of leva.

Electromagnetic Lifters Improving the State of the Art

These lifters have been designed by a team of young people in the electrical supply and equipment department of the V. I. Lenin Higher Institute of Mechanical and Electrical Engineering in Sofia. Unlike their conventional electromagnetic cousins, they do not drop the metal which they lift and the articles held when the electricity is switched off, and they consume virtually no electric energy. The miracle lies in the system devised for magnetizing and demagnetizing, which places the magnetic gripping devices in the operating position. It is enough to emit brief electric pulses from the control unit, which are tenths of a second in duration, and an article sticks to the lifting device. The grip is "dead," and the article is not released until the demagnetizing button is pressed. Precision gripping is the weak point of manipulators and robots of complicated and costly structure, along with other deficiencies. The magnetic grips of original design more firmly grasp articles of different shapes and sizes on skids, conveyor belts, and so forth.

This is one of the potential applications of the gripping devices, which essentially are universal. Being made up of modules and varying in gripping

power, they can replace powerful electromagnetic cranes in carrying heavy sheets of steel and blocks of metal. They will replace the electromagnetic plates of grinding machines, which consume electricity continuously and by heating up impair the accuracy of machining. With their dead grip, the new devices will hold machine parts stationary during welding and will be used to grip parts worked by other metal-cutting machine tools. These devices are already in production at the Beroe Scientific Production Industrial Robotics Complex in Stara Zagora and the Aleksandur Chopev plant in Velingrad.

Fantastic Liquid Force

The essential feature of the new technology is that parts are machined by plastic deformation in the cold state under the action of lubricating liquids under high pressure. Behind this concise description lie many years of work by engineer Georgi Kostov and his staff resulting in a package of inventions which have brought to life technologies for hydroplastic working of cylinders, long machine parts, gear teeth, pipes, etc. These technologies have all been developed at Gabrovo and have been introduced at a number of machinebuilding plants. We give as an example a description of the operation of an installation for final machining of cylindrical parts consisting basically of a cylinder in which a lubricating liquid is pressurized, a hollow rod through which the liquid passes, and a metal-working toool. The tool is designed in such a way that closed deformation spaces are formed between the tool and the surface to be worked. The liquid acts under high pressure in these spaces. Several standard operations, such as rough and fine boring, grinding, and honing are definitively replaced.

The first flexible automated production system for finishing treatment of gear teeth, embodying six hydroplastic treatment inventions, was exhibited at the autumn industrial fair in Plovdiv last year. The system has six modules through which gear wheels are passed in sequence by manipulators and robots. In the first module the internal opening of the gear wheels underrgoes combined mechanical and hydroplastic working, and in the second module a second bank of machines cuts the gear ring. This is followed by chip removal, degreasing, and phosphating in the baths of the third module. The gear teeth then go to the fourth module, where they undergo final hydroplastic working. which is 20 times more efficient than the currently known ethods of finishing treatment. Lastly, the robot transfers the gear wheels to the fifth module for surface hardening of the gear rings, and in the sixth module bearings are packed into the central opening. In one hour 400 gear wheels are turned out with no concern as to their quality. The system is run by a single operator, and its operation is monitored and controlled by a microprocessor.

The process of invention is a marathon in which the goal constantly recedes into the distance. There is no stopping, and Bulgaria is not stopping. Strong, young, and confident, it is moving ahead, in many respects outstripping even the most highly developed countries.

6115
CSO: 2202/24

STATEMENT BY JOHN ATANASOV ON POSSIBLE COMPUTER USE

Sofia RODOLYUBIE in Bulgarian No 9, 1985 pp 23-24

[Article: "Prof John Atanasov on Computers, War, Literacy"]

[Text] The father of the computer, he may be said to have been the most esteemed guest at the international conference held in Varna. It is not surprising that each of his visits to Bulgaria is an event. He is 82 years old, a very busy man, mathematician, physicist, inventor, and honorary member of the Bulgarian Academy of Sciences. On this occasion he and his wife stay longer. He visits the homes of his ancestors, relaxes in the shadow of the Balkan Mountains, his Bulgarian blood coursing through his veins. And he states quite simply, without posturing, that Bulgaria is his love.

"Any means of warfare is repulsive to me," he says, observing with sadness that the computer is used for inhumane purposes around the world. "While this machine can strengthen the intellectual capabilities of man, it unfortunately has no scale of values of its own and often proves to heighten human stupidity. Possibly for this reason, when I was forced to concern myself with military orders, I found an outlet for my conscience by devising a version of a phonetic alphabet which can be used to record any form of speech. I think that all alphabets should be organized on a phonetic principle, and not, for example, like the English alphabet. Many people around the world find it difficult to become literate or are illiterate because of the discrepancies between living speech and the archaic grammatical rules followed for recording it.

Prof Atanasov's phonetic system of writing could facilitate machine translation of texts from one language to another. It could also make things easier for simultaneous interpreters.

"I regret that I myself was not the one who devised the text processing machine," Prof Atanasov said sadly when explaining the advantages of his concept of such a universal alphabet. Perhaps he was thinking of the time in our interview when we were discussing the use of his creation for military purposes.

"We must expand our research on more successful simulation of artificial intelligence. Then computers would not be used exclusively as instruments, but as equal coworkers," added the inventor.

6115
CSO: 2202/24

EXPERIMENTAL USE OF COMPUTERS IN SCHOOLS

Sofia RODOLYUBIE in Bulgarian No 9, 1985 pp 24-25

[Article: "The Computer in the Bulgarian School"]

[Text] The new Bulgarian textbooks could hardly be faulted by George Bernard Shaw, who said that the most awful thing a textbook could be is traditional.

Under the guidance of Academician Blagovest Sendov, the problem group on education under the Bulgarian Academy of Sciences and the Ministry of National Education has prepared new textbooks for the youngest pupils attending the 30 Bulgarian experimental schools. The first-graders with which the group began experimental instruction are now in the 6th grade. The aim is to familiarize children from their youngest years with the computer as machine and technology, to have them study information science not just as a separate school subject, but as a means of more efficient assimilation of other instructional material. Underlying the problem group's concept of modern computerized education is the integrated approach, which is arousing the interest of many foreign guests at the international conference in Varna. The contents of the new Bulgarian textbooks on display at the conference have been made to conform to the integrated approach.

"Specific subject matter from the integrated world is studied in an integrated manner. For example, the problem of energy is examined from the viewpoint of physics, chemistry, biology, etc. An interesting paradox arises. On the one hand, the subject matter includes more concepts and facts, and on the other time is reserved for their explanation and assimilation by the teachers and pupils," explained Kiril Manov, director of the publishing program of Academician Sendov's problem group.

The greatest interest among the participants in the conference was evoked by the textbook "Language and Mathematics" for children in the first grades and by the textbook on information science. In the first one, interesting analogies are drawn between certain structures of language and mathematics, and in the textbook on information science the machine language LOGO is for the first time not a subject of study but is used for teaching things in the integrated world of man.

"This textbook is a small encyclopedia. The information presented in it is not classified by subjects and sections, in the way that traditional

textbooks are written. In this way children begin on their own to search for and discover the connections between things which at first glance seem to have nothing in common. They become investigators and discoverers, instead of being passive consumers of instructional subject matter," said Rumen Nikolov of the Information Science Laboratory of Sofia University, author of two of the new textbooks and inventor of the Bulgarian version of LOGO.

The machine language LOGO was developed in 1968 at the Massachusetts Institute of Technology in the United States. Its authors hardly had any idea that it would be applied as a fundamental language for elementary instruction in information science as microcomputers spread throughout the world on large scale.

Unfortunately, like any technical device, artificial machine languages become obsolete and fall into disuse. The machine language BASIC, for example, is 10 years older than LOGO and reflected the concepts and achievements of information science of its time.

"It is easy to learn, but for that reason also more inconvenient to use, especially when fairly complex problems are to be solved," explained Rumen Nikolov. "It lacks certain fundamental structures typical of the modern languages, such as procedures. But what is more important is that a very good way of thinking is not inculcated by prolonged work with Basic. A person must encode his solution to a particular problem in a language which is highly alien to his way of thinking. Many errors are made in transfer of information, especially by small children."

LOGO has more powerful means of expression than does BASIC. Instead of repeating a certain sequence of operations each time, it identifies them by means of symbols, so that complicated operations can be expressed in a simple manner. Of course, it is not suitable merely as a means of elementary familiarization with information science; as a professional language it possesses the basic array of instruments of artificial intelligence. Perhaps it was for this reason that Erminia Mazinia from Argentina, who is a member of the LOGO Club in Buenos Aires, stated at the conference that, thanks to the potential of this language, third-world countries could leap from the age of illiteracy directly into the age of the second literacy, that is, computer literacy.

Many countries are now using LOGO in native language versions to teach information science. Some African countries, for example, are working with it to heighten the patriotism of children and to fan their interest in learning. The Bulgarian version of LOGO was developed at the beginning of 1985 by Rumen Nikolov and students of the school of physics and mathematics of Kliment Okhridski University in Sofia. Commands are introduced into the computer in Bulgarian, as a result of which the language barrier is broken and the way is cleared for mass computerization in Bulgaria. But the greatest advantage in this context, however, is the fact that we have a unified system of education in operation in Bulgaria.

It is Bulgaria's honor to be the second country in the world after Japan to introduce computers into education as a national policy and to have a computer manufacturing and software production industry of its own, along with instructional aids embodying the most modern subject matter and methods.

6115
CSO: 2202/4

DEPUTY ELECTRONICS MINISTER HIGHLIGHTS INDUSTRY'S PROGRESS

East Berlin PRESSE-INFORMATIONEN in German No 58, 23 May 85 p 2

[Article by Uwe Boegelsack, deputy minister for electrical engineering and electronics: "Product Renewal and Modern Technologies are Closely Interconnected"]

[Text] One of the most important tasks involved in the preparation of the XIth Party Congress of the SED, as was stressed in the consultation of the Central Committee (CC) of the SED with the directors general of the combines and party organizers of the CC last March in Leipzig, consists of bringing about a high degree of renewal in the area of industrial production. On an average, 30 percent of industrial production is to be renewed annually, 40 percent in the case of consumer goods.

A renewal rate of 32.1 percent has been established in the 1985 National Economic Plan for combines operating in the areas of electrical engineering and electronics, based on the specific tasks carried out by this sector. This obliges us to increase even more rapidly the production of new products which will be attractive on the market, while at the same time reducing manufacturing costs and providing all of the prerequisites needed to produce such articles in quantities sufficient to meet demand.

Previous Results Are a Motivating Factor

Among the results achieved in this way during the past year by workers in our sector are a new generation of color television sets with three different picture screen diagonals, energy-saving small fluorescent lamps with a compact design and electronic typewriters and printers. It has once again been proven that both quantities sufficient to meet demand as well as their rational manufacture urgently require that along with the development of new products, modern technologies also be created to allow for their efficient production. The consistent use of microelectronics as a key technology plays a particularly decisive role in this regard. Thus we were successful, for example, in greatly reducing the costs of individual electronic components and in lowering energy consumption for this new generation of color televisions by using specially developed microelectronic circuitry which resulted in a three-fold increase in reliability as compared with previous types of sets.

In general, in the development of new products as well as of corresponding manufacturing technologies, we have made it our objective to ensure a 20 percent improvement in the mass-output ratio, above all by a higher degree of refining of raw materials as well as by the efficient use of materials and energy sources. This can be brought about especially by a reduction in the consumption of specific materials and energy by 25 to 30 percent. These objectives were even surpassed by the collectives of the VEB Narva "Rosa Luxemburg" combine--where a renewal rate of over 30 percent was achieved in 1985--in the manufacture of modern fluorescent lamps. Use of these new, compact fluorescent lamps, for example, makes it possible to reduce energy consumption by 80 percent, compared with ordinary lamps with identical luminosity. At the same time, these lamps have a life expectancy that is 3-5 times greater than that of ordinary lamps.

Both the economic effects which will be achieved because of new products and the requirements for a higher technological level in their manufacture are components of the specification sheets in the plants and combines in the sector of electrical engineering/electronics. In the future, we want to stress in the defenses with even greater consistency that all objectives established in this regard--from technological research to the goal-oriented development of industrial robots, to the creation of measuring and testing technologies, to the expansion of tool and equipment construction--be thoroughly met. In the foreground is especially the need to improve the effectiveness of automated manufacturing technologies that require few attendants, at an even faster rate of speed. But it is also important to evaluate more systematically the results of the experiences that have been acquired with model solutions in our combines.

Among other things, this includes the automatic outfitting of printed circuit boards in the VEB Robotron Electronics plant in Riesa. The installations needed for automatic outfitting and testing by means of computer-controlled diagnostics equipment were developed and produced in the combine's own production rationalization department. In addition to reducing manpower expenditures by 80 percent, this method allows for a consistently high quality. We will continue to introduce such flexible and highly productive manufacturing technologies into the other combines in our sector as well. We also want to make all future development quickly operational, in order to achieve even greater results in the saving of valuable materials and in increased labor productivity, but in particular with regard to an even greater degree of flexibility in the reorientation towards new products.

The Goal is Complex Automation

Especially the last-mentioned goal is of great importance, for in order to attain a complete turn-around of products in two to three years while steadily meeting national economic needs, it is increasingly necessary to create technologies which will make it possible to set up flexible manufacturing stages. For this reason, in our sector we are intensifying efforts to find solutions which, in keeping with the complexity of the reproduction process, are intended to bring about a complex automation from prefabrication on up to assembly and quality control.

By our efforts we are also supporting other sectors of the national economy. Of great importance are, for example, the modern control devices for tool machines and industrial robots from the "VEB Numerik Karl Marx" in the introduction of rationalization technologies and the development of semi-automated production units in the continued automation of machine construction, but also for the areas of metallurgy and the chemical industry. Within the framework of the competition for the preparation of the XIth Party Congress of the SED, workers in the fields of electrical engineering and electronics want to continue to increase their contribution to the growth of productivity in the national economy, above all by increasing the availability of new microelectronic products.

12792
CSO: 2302/103

TRENDS IN MICROELECTRONICS DEVELOPMENT, APPLICATIONS

East Berlin NACHRICHTENTECHNIK-ELEKTRONIK in German Vol 35, No 9, Sep 85 pp 322-327

[Report by R. Koestner et al. from the Mittweida College of Engineering, Computer Electronics Section: "Development of Microelectronics and Its Influence on Systems Engineering"]

[Text] 1. Microelectronics—Various Factors in Current Scientific-Technical Development

Current scientific-technical development is fundamentally characterized by elaboration and application of new technologies based on the principles of chemistry and physics. One of these technologies is focused on the highly efficient production of electronic circuits, referred to by the collective expression "microelectronics." Microelectronics makes possible the production of electronic circuits of heretofore unattainable complexity and reliability and at quite favorable costs. Specifically, the reliability factor forces the application of microelectronics with the qualitative changes in the cost/performance ratio stimulating this application. Microelectronic products are thus characterized by a distinct increase in functional value with a simultaneous decline in expense: $\left(\frac{dGW(t)}{dt} > 0; \frac{dW(t)}{dt} < 0!!\right)$. This means that integrated circuit [IC] manufactures and users are equally interested in extensive adoption of microelectronics. This leads to unusually high rates of innovation. In data processing, this has the effect, for example, that approximately every 5 years new systems come into use with cost/performance ratios improved by a factor of 4[1].

The effects of the current insertion of microelectronics (processors and microcomputers in particular) are comparable to those of the insertion of powered machines (especially electric motors) at the time of the industrial revolution.

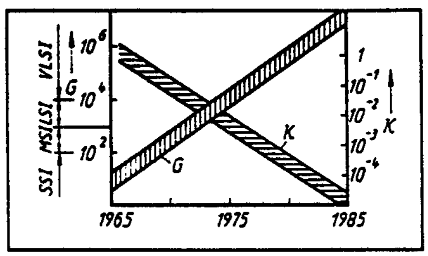
While the powered machines led to distinct developments in individual production processes, microelectronics gives new dimensions to the development

of data processing techniques. The focal point of this is the mechanical production of data processing components and the intensification of technological processes in the form of comprehensive automation which this makes possible[2,3].

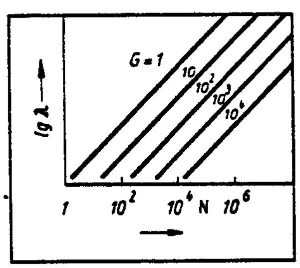
2. Development of Microelectronics

2.1 The Push for Higher Levels of Integration

The development of microelectronics has been characterized, from the creation of the first IC in the early sixties, by the relentless push for higher levels of integration. Today, production of silicon chips with approximately 100,000 components (64 k RAM) has been mastered by several manufacturers and the trend continues to grow. The driving forces behind this are the growing functionality which increases with the complexity of the circuits as well as the rising reliability and the falling costs per integrated element, or function (Illus. 1 and 2).

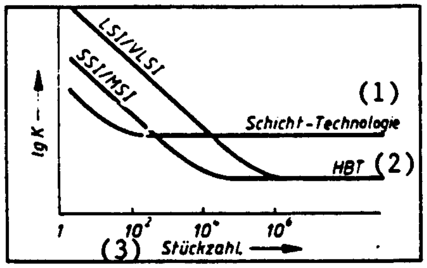


Illus. 1. Development of the level of integration G (elements or functions per chip) and the relative cost K per element or function.



Illus. 2. Correlation of the failure rate Λ of a device with the number N of elements or functions included. Parameters: level of integration G (elements or functions per IC).

The low costs come into effect as soon as a certain minimum production quantity is reached. Minimum piece numbers lie in the range of from 10^4 to 10^6 and increase with rising levels of integration (Illus. 3).



Illus. 3. Costs K of an IC correlated with the quantity produced.

Key:
1. Layer technology
2. HBT [expansion unknown]
3. Quantity

One problem for the industry is that the declining range of application of an IC caused by increasing complexity due to specialization of the function of the circuit results in a decrease in the necessary quantity of a particular type. That is in contradiction to the above mentioned requirement of assurance of a certain minimum production quantity and has decisively influenced the general development of microelectronics. Two major groups of IC's have thus developed (Illus. 4):

—standard IC's and
—customized IC's.

Their transmission characteristics may often be programmed either by the user or by the manufacturer.

2.2. Standard IC's

Standard IC's are characterized by their universal usability by extremely diverse users. There is a wide assortment of standard IC families including well coordinated circuits for specific ranges of application. With them and with the use of the programmability of many of these IC's, it is possible to adapt more or less optimally to virtually all jobs required of IC's.

Typical examples are

—IC's for control and automatic control technology, for example, operational amplifiers, multipliers and power amplifiers. Their transmission characteristics are widely programmable through external wiring.

—IC's for radio, television and phonograph technology.

—TTL IC's for performing simple combinational and sequential basic functions as well as more complex groups of functions in the form of counters, dividers, shift registers, decoders, multiplexors and arithmetic circuits.

—Microprocessor IC's which can be adapted to an extremely wide range of possible uses through software programming.

—Storage in the form of static and dynamic RAM, PROM, EPROM AND EEPROM.

—Analog to digital/digital to analog converters.

Illus. 4. Standard and Customized IC's

<u>Integrated Circuits</u>

<u>Standard IC's</u>

-Operational amplifiers
-Multipliers
-Power amplifiers
-IC's for phonographs, radios and televisions
-Power supply units
-TTL IC's (for combinational and sequential basic functions, counters, dividers, shift registers, decoders, multiplexors and arithmetic circuits)
-Microprocessor IC's (CPU, PIO, SIO) for 8, 16 and 32 bit)
-Memory (static and dynamic RAM, PROM, EPROM, EEPROM)
-Digital to analog/analog to digital converters

<u>Customized IC's</u>

<u>Semicustomized</u>

-Mono- or IC chips
-Gate arrays (PLA, ULA)
-ROM storage

<u>Fully Customized</u>

-Standard cells
-Macrocells
-Chip assemblers
-Silicon compilers

Standard IC's have the advantage of general availability; they are produced by all the semiconductor firms in the world in large quantities and under numerous technologies. They are favorably priced and are designed for their function. Nevertheless, especially in the area of great complexity, the use of standard IC's is not always reasonable and economical. That is obvious, for example, in those areas where extremely high processing speeds are required.

2.3. Customized IC's

Customized IC's are designed and manufactured to the order of the client for a specific application. The technical circuitry solutions obtainable here are frequently less complicated and more efficient than variations made on standard IC's (especially in terms of software). The use of customized IC's is to be recommended when the quantities needed are large enough that, in spite of high development costs, a price can be arrived at which can compete

with the more expensive adaptation of standard IC's and especially with their high software cost component. In addition, longer delivery deadlines (due to the longer development period) must be accepted.

There are two distinct categories:

—Semicustomized and

—Fully customized.

In semicustomized IC's standardized elements or function groups (design components) are used which are laid out in the chip and connected —usually with the help of CAD (computer assisted design)—according to client specifications. Depending on the design components, the distinction is made between mono- or IC chips and gate arrays.

—Mono- or integrated circuit chips contain different npn- and pnp-transistors as well as numerous resistors (there are typically approximately 500 elements per chip), which are linked by a data path mask according to client specifications. For digital applications, simple gate arrays also are available in NMOS-, CMOS- and I^2L metallic oxide technology. Maximum operating voltages lie between 20 and 36 V. To support development of circuits, transistor and resistor arrays (i.e. partial circuitry) for individual chips are available[4,5].

—Gate arrays consist of basic cells (gates) arranged in ranks and columns (Illus. 5). The basic cells embody groups of components either not connected or only partially connected. Members of the gate array family are PLA's (programmable logic arrays) and ULA's (uncommitted logic arrays)[6].

PLA's contain cells arranged in a matrix with AND input and OR output channels, which are connected via a first data path mask to elementary logical function units (AND, OR) and are mask-programmed with the help of a second data path level.

ULA's consist of cells arranged in ranks and columns with several unconnected transistors and resistors. The circuitry connection is accomplished by a client specific data path mask. Digital and analog circuits are possible because of the free access to all components.

Likewise included in the semicustomized IC group are the ROM's. This is permanent memory irreversibly programmed by the manufacture to client specification. This programming is accomplished through variation in the data path mask or in the gate oxide thickness. The importance of ROM is decreasing since in the near future it will be increasingly superseded by EPROM.

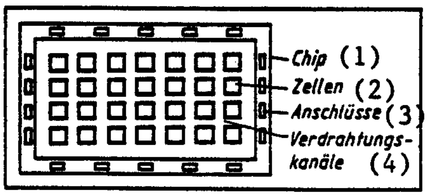
For all semicustomized IC's, economical minimum quantities of about 1000 and development periods of 1 to 2 months are characteristic. The disadvantages of these IC's are in the limitations caused by specialization in the circuit design and the incomplete use of chip surface.

For fully customized IC's, standardized function groups (design components) are used, the parameters of which are stored in memory in a program library and which are positioned in the chip and wired using CAD. Bipolar and unipolar technologies are used with CMOS technology becoming increasingly prevalent. Standard cells and macrocells are distinguished from one another on the basis of their design components[6].

—Standard cells contain basic circuits in the form of differential amplifiers, NAND gates, NOR gates, flip-flops, etc. The cells have a standardized height and are arranged in ranks[6].

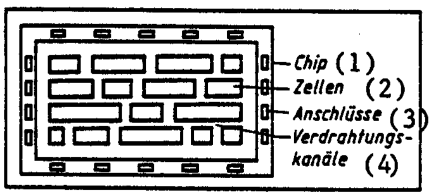
—Macrocells, also called universal cells, contain more complex circuits, for example, operational amplifiers, shift registers, counters, decoders, etc. The size of the cells is discretionary (Illus. 7).

The minimum economical quantity for fully customized IC's runs about 50,000; development periods are from 3 to 6 months.



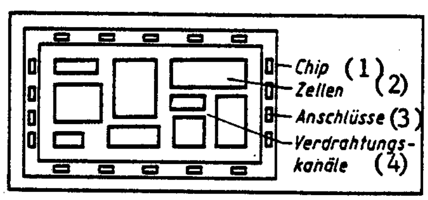
Key:
1. Chip
2. Cells
3. Connectors
4. Wiring channels

Illus. 5. Gate Array: fixed chip size, fixed cell quantity, fixed connector quantity, fixed cell height, fixed cell width, fixed wiring channels



Key:
1. Chip
2. Cells
3. Connectors
4. Wiring channels

Illus. 6. Standard cell: variable chip size, variable cell quantity, variable connector quantity, fixed cell height, variable cell width, variable wiring channels



Key:
1. Chip
2. Cells
3. Connectors
4. Wiring channels

Illus. 7. Macrocells (universal cells): variable chip size, variable cell quantity, variable connector quantity, variable cell height, variable cell width, variable wiring channels

2.4. Trends

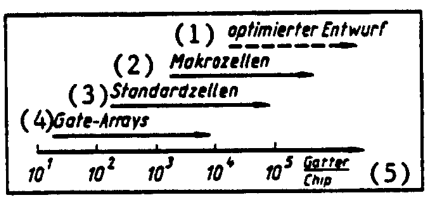
In the area of standard IC's, further developmental work will concentrate on processors and memories. For processors, the major concentration is on preparation of an assortment of universal processors with 16 and 32 bit processing ranges.

For memory IC's, increasing storage capacity and reducing access time are major goals. Developmental work is in progress on the following IC's:

1 Mbit dynamic RAM; t<100 ns
64 kbit and 256 kbit static RAM; t<50 ns
256 kbit, 512 kbit and 1 Mbit EPROM; t<200 ns.

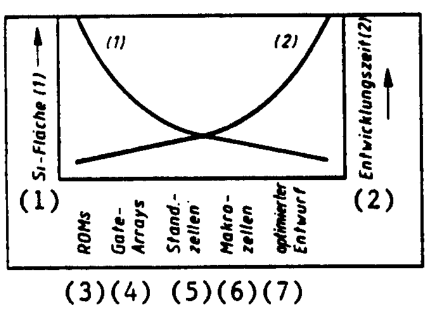
For very fast memories gate arrays are used. With them, 4 kbit static RAM's with access times of from 3 to 4 ns are currently producible. Mass storage devices will likewise be produced as semiconductor memories in the future. Wafer scale integration is capable of producing 4 to 8 Mbyte of RAM and 16 to 32 Mbyte of ROM[7].

Beginning in 1990, it is estimated that 50 percent of all IC's will be customized. Based on their design, development ranges with increasing complexity from gate arrays to macrocells (Illus. 8). A change in the silicon surface required and the development period is linked to this (Illus. 9). In the future it is especially important that the development periods be reduced[1,6].



Key:
1. Optimized design
2. Macrocells
3. Standard cells
4. Gate Arrays
5. Gates per chip

Illus. 8. Degree of complexity of various design components



Key:
1. Silicon surface
2. Development period
3. ROM's
4. Gate arrays
5. Standard cells
6. Macrocells
7. Optimized design

Illus. 9. Silicon surface and development period correlated to design components

The gate array is currently dominant; the following data are typical:

—number of gates	2500/chip
—gate propagation time	350 ps
—technology	OXIS [expansion unknown]
—number of wiring layers	3
—chip surface	80 mm^2

The goals for standard cells (1985) are:

—number of cells	100,000/chip
—gate propagation time	1 ns
—technology	CMOS
—number of wiring layers	3 to 4.

It is predicted that in 1986 gate arrays and standard cells will be used in a ratio of approximately 2 to 1. Within that CMOS technology will be the most prevalent with approximately 55 percent[8].

Further progress will be obtainable through the expansion of software aids. Examples of this are the so-called chip assembler and silicon compiler. They convert the description of the functional and temporal relationship of the system to be created directly into the data necessary for the layout, or semiconductor production process, and this is where optimal design enters the picture. No prediction is currently possible about when this ideal goal will be reached.

The functions of future customized IC's will be heavily oriented toward processors. Based on areas of application, the following groups will be developed[9]:

—arithmetic processors and specialized computers,
i.e., IC's with system superstructures similar to those in microprocessors and pocket computers. Examples of these are structures for special arithmetic operations such as multiplier fields and divider fields as well as specialized computers for finance, transportation, etc.

—special processors and control devices,
i.e., IC's for controlling specific equipment and systems, e.g., computer peripherals, storage systems, household appliances. Also included here are processors for on-screen graphics, telephone equipment, electronic games, etc.

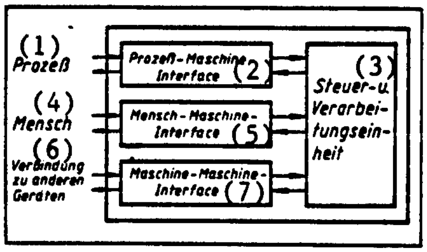
—signal processors
These are controlled data paths for conversion, analysis and synthesis of analog and digital signals. Here are included processors for mathematical analysis of signals (Fourier analysis), processors for signal filtration (digital filters), for image processing, for speech analysis and synthesis, etc.

—message processors
These are controlled data paths used chiefly for conversion of signals for the transmission of messages (for example, PCM [pulse code modulation] and

connection of signal paths for transmission of messages, for example, Codec IC's with filters.

3. Products of Systems Engineering and the Influence of Microelectronics

The term "system" generally refers to a compact, closed system for capture, processing and presentation of information. Systems are used in the manufacturing process for rationalization and automation of production as well as in the processing of information and communications[10,11]. The systems elements required for this can be shown in general terms (Illus. 10).



Illus. 10. System model

Key:
1. Process
2. Process-machine interface
3. Control and processing unit
4. Person
5. Person-machine interface
6. Link to other systems
7. Machine-machine interface

The three interface units fulfill the following roles:

—process-machine interface: capture of process parameters by means of sensors; intervention in the process via corresponding devices

—person-machine interface: control; display of selected data; dialogue

—machine-machine interface: linkage to other systems and installations.

A control and processing unit is necessary for the control and processing of the influences affecting the system via the interface components. It performs the essentially constant central functions of the system; among them:

—management of system resources and
—processing of data available to the system in the form of images of external processes (coordination, synchronization, calculation, storage, etc.).

The different interface and central functions are carried out differently case by case or are developed differently. While until just recently, numerous mechanical principles were included in systems, and data processing was

generally carried out in analog form, with the universal application of microelectronics and microcomputer technology, the following new developmental trends are observable:

—All systems evolve according to their central functions into electronic systems of higher complexity.

—In the process-machine interface, other work principles (for example, mechanical, pneumatic, optical, etc.) continue to be used along with electric devices. That is, they are not disappearing, but rather new and much more complicated tasks are being carried out by them, especially in the area of sensors and devices (for example, robots).

—In the person-machine interface, new forms of data input and output are being used (for example, control dialogue via graphics display, voice communication) and through them a new quality of person-machine relationships established.

—Machine-machine interfaces are increasingly being handled via bus systems.

—In the control and processing unit, digital signal processing is preferred. More and more, universally adjustable components are being installed in the form of freely programmable computer units. Adaptation to the specifications of each respective application is accomplished via programming.

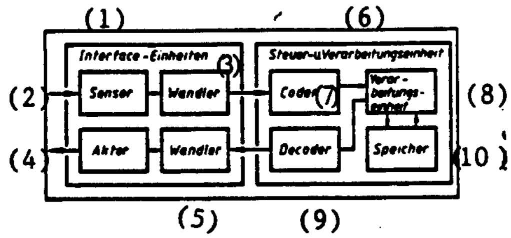
Hardware modifications result from[12]:

-the range of functions: number and complexity of algorithms required
-time conditions: reaction and throughput requirements
-storage needs: data buffering, status registers
-I/O channels: form, number, organization, accuracy
-other production conditions: design, energy, thermal and economic requirements.

—The physical structure of the systems is influenced by:

-continued miniaturization
-partial replacement of mechanical and electromechanical components by electronic units
-use of modularly constructed functional components with standardized dimensions
-use of new assembly technologies.

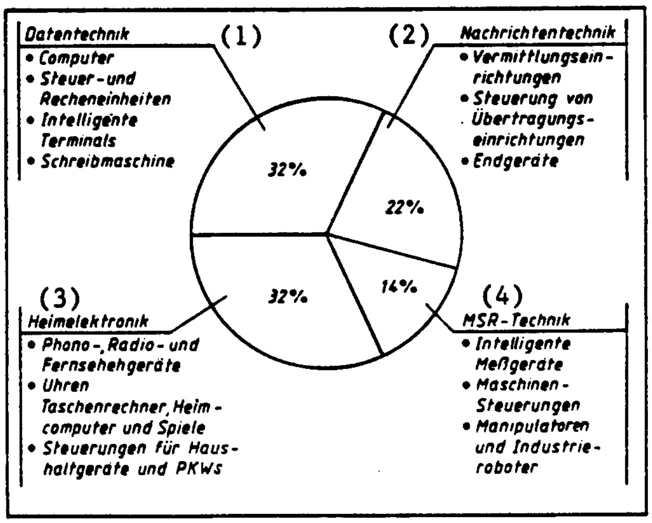
With reference to this influence of microelectronics, the data processing chain shown in Illus. 11 can be cited as an example of the interaction of the process-machine interface and control and processing units.



Illus. 11. Data processing chain

Key:

1. Interface units
2. Sensor
3. Converter
4. Activator
5. Converter
6. Control and processing units
7. Encoder
8. Processing unit
9. Decoder
10. Memory



Illus. 12. Current areas of concentration for application of microelectronics in the construction of systems

Key:

1. Information engineering
   - Computers
   - Control and calculation units
   - Intelligent terminals
   - Word processors

2. Communications engineering
   - Switchboards
   - Control of transmission devices
   - Terminals

3. Household electronics
   - Phonograph, radio and TV systems
   - Clocks, pocket computers, personal computers and games
   - Controls for household systems and automobiles

4. MSR [expansion unknown] engineering
   - Intelligent measuring devices
   - Machine controls
   - Manipulation devices and industrial robots

The current areas of concentration for the use of microelectronics in construction of systems are presented in Illus. 12[12,13]. Their volume will change only slightly in the next few years and can thus be characterized as follows:

—Production automation systems

-preproduction: establishment of computer assisted planning, design and construction (CAD/CAM methods)
-production implementation: NC [numerical control] machines and industrial robots
-production control: intelligent measuring instruments, devices for real-time control as well as for computer assisted analyses and accounting.

—Communication (Person-person-machine-machine) and data processing systems[14,15]

-Equipment for new data networks and services
-Intelligent terminals
-Object recognition systems
-Super computers with extensive data bases and networks

—Household electronics systems and social services systems

-clocks, control devices for automobiles and household equipment
-pocket calculators, personal computers
-audio and video technology including video library
-social services
-aids for hearing, speech and sight, heart pacemakers and other organ controls, diagnostic and therapy systems

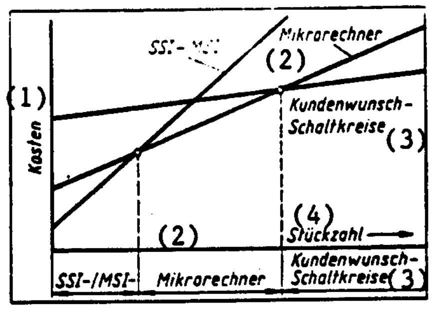
4. Microelectronics Approaches

Within the development of the different systems designs with microelectronic IC's, there is a choice of three basic approaches:

—Approaches with SSI and MSI standard IC's
—Approaches with LSI and VLSI standard IC's, especially with microcomputer structures
—Approaches with customized IC's.

The profitability ranges for these variants depend on the quantity of systems to be produced (Illus. 13). Along with these economic criteria, the technical characteristics presented in Table 1 are also significant in the assessment of these variants[16].

Microcomputer approaches are increasingly preferred. For example, microcomputers with universal processors dominate as control and processing units. In the interface component groups, special processors (customized IC's) are frequently used for process control, but also in direct linkage with sensory analysis, activation and conversion.



Key:
1. Costs
2. Microcomputers
3. Customized IC's
4. Quantity

Illus. 13. Profitability ranges for various approaches

Table 1. Technical criteria for assessment of various approaches

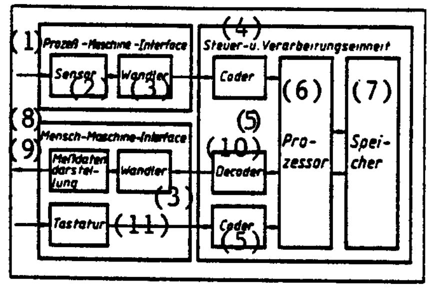
Characteristics	Approaches using SSI/MSI	Micros	Customized IC's
Processing speed	++	-/+	+
Power consumption	-/+	+	++
Volumes	-	+	++
Reliability	-	+	++
Flexibility	+	++	--
Development period	+	++	--
Spare parts acquisition	++	+	-

The block diagrams of systems shown in Illus. 14 and 15 for extremely different applications emphasize the advantages of the microcomputer approach[17].

Certain limitations result from the use of universal microcomputer IC's due to

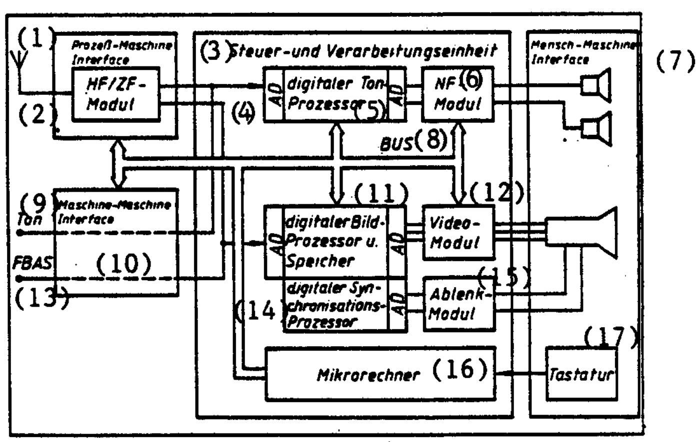
—relatively low processing speed
—comparatively high space requirement
—high cost of problem specific software development (hardware to software cost ratio = 1 : 5; software crisis).

Therefore, when relatively high quantities are involved, design and use of customized IC's "tailored" to the specific problem is recommended.



Illus. 14. Block diagram for an autonomous measuring device

Key:
1. Process-machine interface
2. Sensor
3. Converter
4. Control and processing unit
5. Encoder
6. Processor
7. Memory
8. Person-machine interface
9. Display of measurement data
10. Decoder
11. Keyboard



Illus. 15. Block diagram of a future television set

Key:
1. Process-machine interface
2. RF/IF module
3. Control and processing unit
4. Analog to digital converter
5. Digital audio processor
6. LF module
7. Person-machine interface
8. Bus
9. Audio
10. Machine-machine interface
11. Digital image processor and memory
12. Video module
13. Video signal
14. Digital synchronization processor
15. Scanning module
16. Microcomputer
17. Tuner pad

Many of the problems related to the microelectronic production of equipment and systems are still very much in a state of flux or still call for the general approach. These include:

--creation and application of suitable, highly standardized operating systems for

-personal computers (software class CP/M [control program for microcomputers])
-control and calculation units (software class iRMX [expansion unknown])

--creation of interactive programming systems

--creation of developmental aids for development and programming of processors and customized IC's (CAD/CAM)

--further development of hardware components, especially of

-efficient, highly adaptable interface units (sensors, activators, implementation devices)
-high speed, high capacity memory units[18]
-signal processors and specialized processors

--creation and application of systems construction standards

--assurance of better quality in education and continued training taking into account the complex interaction between systems engineers and semiconductor engineers, computer scientists and extremely diverse users[19].

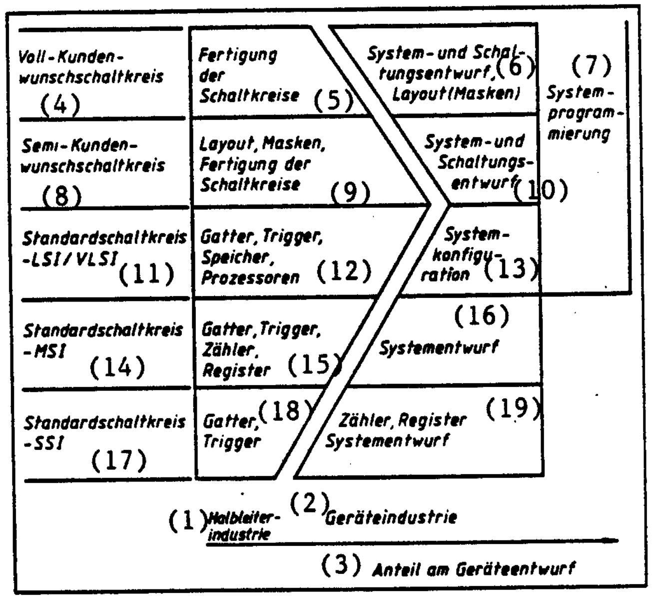
5. Interaction of the Systems Industry and the Semiconductor Industry

Depending on the level of integration of circuits and the different IC categories (standard IC's, customized IC's), the interaction between the systems industry and the semiconductor industry has been affected in very distinct ways (Illus. 16).

With the use of standard IC's, at first a clear shift of circuit and systems development from the systems manufacturer (user) to the semiconductor producer was observable. That changed with the increasing use of customized IC's and led to the current situation in which there is a return of the developmental tasks to the user.

Currently, chiefly with the use of semi-customized IC's, the interface between the systems industry and the semiconductor industry can be characterized as shown in Illus. 17[6].

In the future, with the predominance of fully customized IC's, the systems engineer will develop his own circuits and systems with his own design components (e.g., macrocells) and his own CAD machine tools, and the semiconductor engineer will prepare the necessary technological devices for production. The success of this procedure is highly dependent upon well developed cooperation based on trust between the two partners.



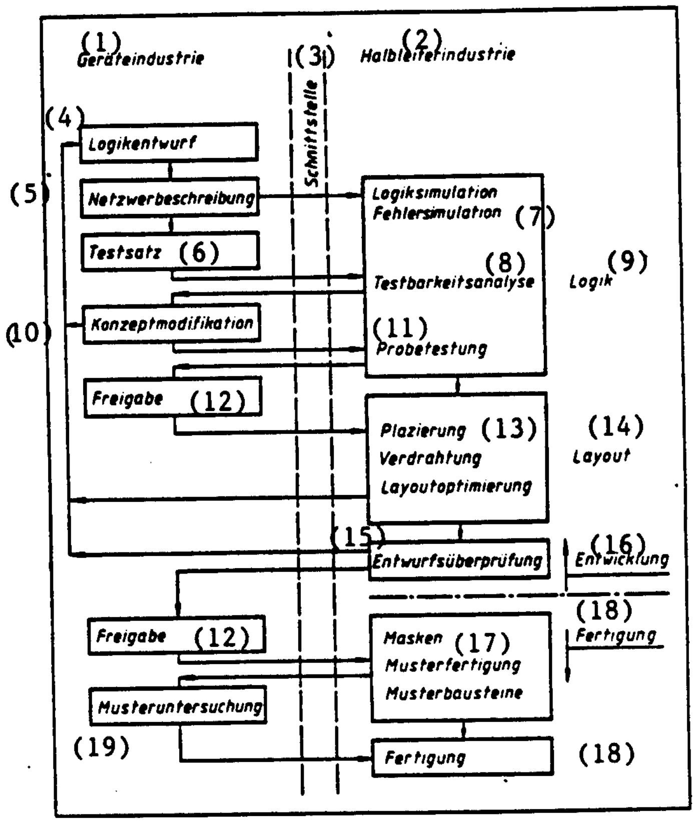
Illus. 16. Influence of the level of integration and of the different IC categories on interaction between the systems industry and the semiconductor industry

Key:

1. Semiconductor industry
2. Systems industry
3. Share in design of systems
4. Fully customized IC's
5. Production of IC's
6. Design of systems and circuits, layout (masking)
7. System programming
8. Semicustomized IC's
9. Layout, masking, production of IC's
10. Design of systems and circuits
11. Standard IC's--LSI/VLSI
12. Gates, triggers, memories, processors
13. System configuration
14. Standard IC's--MSI
15. Gates, triggers, counters, registers
16. System design
17. Standard IC's--SSI
18. Gates, triggers
19. Counters, registers, system design

The development effort and development time which must be considered for the systems engineers and the semiconductor engineers are determined by the complexity of the IC's and by the basic design components utilized (Illus. 18)[6].

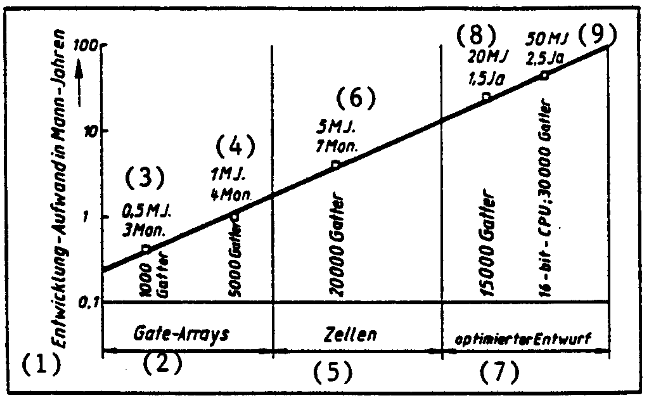
While, with a complexity of 1000 circuits and with the use of gate arrays, developmental periods of 3 months with a development effort of 0.5 man-years are attainable, 2.5 years and 50 man-years are indicated as typical for a 16 bit CPU (30,000 circuits) with optimized design. Along with 10 times the amount of time, 100 times the effort (basically a larger developmental group) is the primary consideration.



Illus. 17. Interface between the systems industry and the semiconductor industry in the development and production of semicustomized IC's

Key:

1. Systems industry
2. Semiconductor industry
3. Interface
4. Mathematical conception
5. Network prospectus
6. (Testsatz)
7. Mathematical simulation
   Error simulation
8. (Testbarkeitsanalyse)
9. Logic
10. Design modification
11. Preliminary testing
12. Delivery
13. Layout, wiring, layout optimizing
14. Layout
15. Revision of design
16. Development
17. Masking, pilot production, samples
18. Production
19. Testing of the sample



Illus. 18. Development effort and development period

Key:
1. Development effort in man-years
2. Gate arrays
3. 0.5 man years/3 months—1,000 circuits
4. 1 man-year/4 months—5,000 circuits
5. Cells
6. 5 man-years/7 months—20,000 circuits
7. Optimized design
8. 20 man-years/1.5 years—15,000 circuits
9. 50 man-years/2.5 years—16 bit CPU; 30,000 circuits

Developmental periods in excess of 3 years are out of the question since they no longer fall within the requirements of the innovation cycle characteristic of microelectronics.

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GERMAN DEMOCRATIC REPUBLIC

CHAMBER OF TECHNOLOGY VP ON ELECTRICAL ENGINEERING TRAINING

East Berlin ELEKTRIE in German Vol 39 No 7, 1985 p 243

[Article by Prof Dr. Peter Klaus Budig, Vice President, Chamber of Technology, Dean, Electrical Engineering Faculty, Karl-Marx-Stadt College of Engineering]

[Text] This issue of our trade journal "Elektrie" is not devoted exclusively to one important topic. It is therefore tempting to reflect on the future developments in the field and to consider how the training of future generations of scientists can do justice to these tendencies. The task of electrical engineering is the manufacturing, transportation, distribution and transformation of electrical energy into other forms of energy. For the latter, electrical propulsion plays an important role, as a hefty 50 to 60 percent of electrical energy is utilized for this purpose. It can clearly be recognized that, in addition to consumers such as lighting technology, transportation and the energy needs in homes, the application of electrical energy in technological processes is becoming increasingly necessary. In addition to the processes for the melting and welding of metals as well as in galvanic processes, other uses such as plasma, electron and ion radiation processes are appearing. Laser technology is becoming interesting.

Whatever task is taken up within the field of electrical engineering, it is characterized by the reciprocity of materials expenditure and resulting losses. Minimal material expenditure is of great importance in electrical, magnetic, hydraulic and thermal systems.

The solution would therefore seem to involve approaching the possible limits of materials by means of dimensioning processes and seeking optimal solutions. But there is also the demand for new materials. In this regard, hard and soft magnetic materials, insulation and construction materials are of particular interest, for in the traditional conductor materials copper and aluminum, the technically feasible limits have already been reached.

With the products, only small quantities of energy can be saved. Major effects can result from process controls in the processes mentioned at the beginning of this article. Computerization is a major factor here. The task is to create automated process controls that are designed according to predefined optimization criteria. Electronic process control, facilitated by CRT-control point technology, automated storage of process data and electronic

help in startup, shut-down and damage situations, serves more and more as interface between humans and the process.

Questions regarding significant process measuring units and their documentation and propagation arise as well. The hardware of microelectronics and the software methods of information management form a decisive basis for the processes fueled by electrical energy. Thus, there is a convergence of energy-oriented and information-oriented electrical engineering.

The necessity of shortening delivery times and of a deep theoretical transcending of processes and systems in electrical engineering requires the implementation of computers in the planning and construction of products and in the creation of technological designs. A deep penetration of physics and information flow prove that designs can be created quickly, that the comparison of variables becomes possible and optimal solutions are found--whereby the optimum may be determined according to the task at hand. Completely new tasks arise from program design, data storage, and optimization strategy design. Basic knowledge in the areas of computer technology, information sciences and cybernetics are required for this.

Human knowledge grows with such rapidity that it is impossible for education to keep pace with new discoveries. For this reason it is necessary to be reminded of the time-constant foundations and to design the process of study in such a way as to educate a specialist who is willing and able to undergo continued education. Specialization must take second place during education in favor of a solid education in the basics of the engineering discipline and of the area of specialization. To the first, knowledge and abilities useful in other areas of specialization belong as well, such as technical cybernetics and automation technology. If one looks at engineering education from this angle, one can see that the experience in education which in the GDR has been developing for decades in the fields of

1. social sciences
2. mathematics/natural sciences
3. basics of electrical engineering and electronics and
4. engineering design, technology and materials science

is joined by a field equal in importance, i.e.

5. cybernetics and information sciences.

This field includes areas such as systems analysis, control design for linear and non-linear environments, reader systems, hardware, programming, model design and simulations. Just like mathematics or physics, these areas are to be viewed as the "toolbox" of the engineer.

During specialized training, which in this discipline fortunately begins as early as the first semester, the basics of products and processes of electrical engineering and their automation are to be taught in such a way that a sufficient depth is reached in such sub-areas as energy systems, major energy installations, electrical propulsion systems, electrical technology, electrical engineering in the home and special applications of electrical engineering, eg. for ships or motor vehicles.

Specialization should be delayed until after actual practice has begun. An increasingly important role is being played by continuing education. This is a matter of supplying specialists who are actually engaged in work with information concerning new developments in their field as well of transferring up-to-date research results by means of training. These are two very different objectives requiring different methods and teaching materials. As always, in the future, too, continuing education based on individual initiative will continue to play a decisive role.
College professors, practitioners and students in the GDR are responding to the many challenges involved in the restructuring of the educational process under the aspect of the rapidly developing field of specialization and bold estimates concerning the tasks which can be expected after the year 2000, and in this way they bring life to the resolution of the Politburo of the SED and the Council of Ministers of the GDR.

12792
2302/106

CAD/CAE IN TRAINING OF ELECTRICAL ENGINEERS VIEWED

East Berlin ELEKTRIE in German Vol 39 No 5, 1985 p 163

[Article by Prof Dr Eberhard Paulig, Director, Electrical Engineering Department, Dresden Technical University]

[Text] With the initiative program of the 8th Congress of the KDT [Chamber of Technology] regarding the application of microelectronics, the members of our socialist engineering organization take up the new challenges regarding the development, production and implementation of highly integrated systems configurations in all areas of the national economy. This development not only concerns new products and technologies with a high degree of automation and refining in materials production, it also brings about drastic changes in the workplace and tools of the trade of the engineer. Thus the underlying aspects are:

-the limited radius of action and the overly slow work pace of humans, especially in the design and manufacture of VLSI [Very Large Scale Integration] elements in microelectronics, but also in the complex configurations of automated plant construction;

-the need to open up developmental reserves for products and processes via a better theoretical understanding and simultaneous expansion of the amount of data included in the design process;

-the inseparable unity of modeling and experimental confirmation of model parameters, from design and simulation of processes and loads during the optimization of products and the design of flexible production lines, including automated measuring and control strategies;

-the high innovation rate in the area of electrical engineering products and the resulting need to shorten developmental and transitional time periods via increased work productivity in the production-preparing areas of construction, project development and technology as well as in the planning and directing of the production process; and last but not least

-enhancing the creative portion of engineering activity within the overall task by reducing the portion taken up by routine work.

The material basis of computer-assisted engineering includes the entire scope of computer technology, from personal computer to the mainframe, both as stand-alone units as well as in network hierarchies with engineering stations with different data access levels, on up to independent CAD/CAM solutions.

In considering this, it would be wrong to view the changes in engineering activity as merely consisting of a stronger trend towards the new material-technological basis brought about by computer technology and the resulting greater percentage of software work. Such a view inevitably leads to the misguided assessment that in the future we will no longer need engineers, but only data processing specialists. The area of activity for the engineer is still that of materials production. The engineer is confronted with the task of developing new products and technologies, of using materials and energy economically, and of realizing a production process that to an ever increasing extent is automated. The implementation of microcomputer technology in this process is, on the one hand, part of product and process design; on the other hand, it is the means to the end of increasing the efficiency of engineering itself, as well.

In this development, the microcomputer has a particularly important function. With the increase of registers from 8 to 16 or 32 bits, the increase of cycle clock speeds and the construction of multi-processor systems as well as storage capacities that are, with the inclusion of external storage media, counted in megabytes, the personal computer of the '80s surpasses the performance of minicomputers of the previous decade, and with dialogue-oriented modes and the possibility of integration into the workplace of the engineer, it has major advantages compared with the computer centers of previous years.

The simplicity of system software of a stand-alone microcomputer configuration that results in a short learning time as well as the attractive price/performance ratio create favorable conditions for broad implementation, a high rationalization impact and a new quality in engineering.

Practice has shown that with the microcomputers and office computers that are available today, a great portion of the tasks involved in product and process development, measurement, control and automation technology can be solved in a new way, often with the utilization of modern mathematical approaches and numerical and statistical solution strategies, while using modular software packages.

With all this in mind, the microcomputer available today is quite a powerful work instrument for the engineer and a precondition for managing the first steps in the design of complex data processing systems. With this as a background, we look at the continuing forum "BASIC-oriented Microcomputers in Engineering" as a major contribution to the stimulation and qualification of a broad segment of practicing engineers as well as of students in accomplishing the objectives outlined by the initiative program of the 8th KDT congress which was cited at the beginning of this article.

12792
CSO: 2302/106

SECOND INTEGRATED CIRCUIT PRODUCTION LINE OPERATIONAL

Budapest HETIVILAGGAZDASAG in Hungarian No 46, 16 Nov 85 p 8

[Text] An important investment of the government microelectronics program which began 2 and 1/2 years ago was officially inaugurated last week. It is the production line for bipolar integrated circuit chips of the Microelectronics Enterprise. The new unit costs approximately 2 billion forints. It was made possible by a government loan, to be repaid in 10 years, and by research and development funds from various sources amounting to 1.5 billion forints. It operates for the most part on the basis of Soviet licenses.

This plant and the MOS production line which became operational a year and a half ago will each have the capacity for making 60,000--a total of 120,000--silicon slices or roughly 20 million chips. Whereas the older unit provided parts chiefly for computer memories and microprocessors, the new one will manufacture linear circuits for industrial and consumer goods use.

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CSO: 2502/19

ELECTRICAL ENGINEERING PRODUCTS SHOWN AT 1984 BRNO FAIR

Warsaw ELEKTRONIKA in Polish No 6, Jun 85 pp 28-33

[Article by Stanislaw Ignatowicz, PhD: "Twenty-Sixth International Engineering Fair, Brno, 1984"]

[Excerpts] The Twenty-Sixth International Engineering Fair at Brno took place on 12-19 September 1984. Exhibits were presented by 2489 participants from 30 nations, as well as from the United Nations Industrial Development Organization. Compared with 1983, the number of participants increased by 241. The total showroom area of the fair was 111,500 m^2. The exhibits were seen by 446,000 visitors.

In electronics, most diverse exhibits were presented by Czechoslovakia, Poland and the GDR among socialist nations, and by the FRG, Japan, Britain and the United States among the capitalist nations. It should be stressed that Poland was among the few nations who have greatly enlarged their participation in this major international fair.

Of most interest in the category of electronic products was process-control equipment and testing and measurement instruments intended for scientific and industrial applications. Electronic subassemblies were represented in a limited nomenclature, and electronics materials had just a token presence.

Gold Medals

A contest for best exhibits of subassemblies and equipment was held at the fair, and gold medals were awarded to the winners. These medals were awarded to 45 products from 14 nations: Czechoslovakia (24 medals), USSR (3), GDR (3), FRG (3), Austria (2), Poland (2), Denmark (1), Japan (1), Liechtenstein (1), Holland (1), Switzerland (1), Sweden (1), Hungary (1) and Britain (1).

In electronics, seven medals were awarded to the following products.

Defectograph MD-12

Manufacturer: Meraster Research and Production Center of Control Systems, Katowice.

Exhibitor: Labimex, Warsaw, Poland.

The defectograph MD-12 is intended for systematic,periodic and nondestructive tests of steel cable wear.* The application of this equipment will greatly improve the operation safety of cable systems. The defectograph uses a magnetic field scattered around damaged sites on the cable. The field is analyzed with a Halltron induction head. The Halltrons are thin-film (with the active film of CdHgTe) type HN25 developed and produced by the Institute of Tele- and Radioengineering in Warsaw.

The defectograph MD-12 evaluates the degree of wear of the cable by adding up all the detected damages that alter the ferromagnetic diameter of the cable (broken wires, corrosion, wire attrition, tangles, missing wire segments, etc.).

The unit consists of a measurement head with a cable length convertor and a three-channel recorder of signals received from the measurement head. It measures the line speed and position. The equipment also has a marker which indicates the damaged sites on the cable.

The defectograph MD-12 can be used on cables of a diameter of 8-85 mm on all types of cable machines, such as elevators, cranes or cable railways. The speed range of testing is 0.1-3 m/s. The maximum length of the tested cable is 9999 m. A complete recording is obtained which adds up all damages on a given segment with a setting from 0.01 to 9.99 m (step 0.01 m). The smallest reduction of the cable detected by the unit is 0.05 percent of its diameter.

The defectograph MD-12 has caused lively interest in foreign markets and is exported in particular to France, the United States and Britain.

The second gold medal received at the Brno 1984 fair by the Polish delegation was:

Dual Action Hydraulic Press PAWN-1000GC

Manufacturer: Hydomat Factory of Special Presses and Dies, Warsaw.

Exhibitor: Metalexport, Warsaw, Poland.

The PAWN-1000GC is an automatic hydraulic press intended for serial production of components stamped from steel plate. By stamping precision and productivity this machine is comparable to those available from the best European manufacturers.

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*The next issue of ELEKTRONIKA (1985, No 7) will carry an article by A. Kuczora entitled "Equipment for Testing Steel Cables," which will give a detailed description of this group of products made by Meraster Center in Katowice.

Polish Electronics Exhibits

In the field of electronic subassemblies and electronic testing and measurement equipment, Poland was represented by the foreign trade agencies Unitra, Metronex and Lamibex.

● Unitra Foreign Trade Enterprise

The exposition presented by Unitra included the following: a group of active and passive electronic subassemblies, a set of elements of vacuum equipment and new measurement and testing units (the latter group was exhibited jointly by Unitra and Metronex Foriegn Trade Enterprises).

The set of a few dozen electronic subassemblies shown at the fair, unfortunately, included no new attractions and basically did not differ from last year's exhibit at the 25th Brno fair in 1983 (see ELEKTRONIKA, No.2, 1984, p 29).

Among the measurement and testing equipment, however, the following three new products from Elmasz Enterprises (Warsaw) deserve attention.

Diagnostic Equipment PS-1467 for Testing Assembled Printed Circuits

The PS-1467 is intended for detecting crossed wires and breaks in printed lines, faulty electron elements, missing elements, misaligned circuit elements and mounting errors of electronic subassemblies during the manufacturing process.

The PS-1467 consists of the following components: diagnostic tester PS-1467, printer RZ-1473, diagnostic stand PR-1474 and optional EPROM memory programmer PR-1454.

The main features of the equipment are:

—resistance measurement range 1 Ω to 50 MΩ with an accuracy of 2-7 percent (depending on the range);

—capacity measurement range 100 pF to 5000 μF with an accuracy of 5-10 percent;

—measurement of voltages at nodes 10 mV - 26 V, accuracy 0.2-5 percent;

—measurement time 1-200 ms;

—memory type EPROM 5 x 2708, capacity 5 kB;

—number of measurements stored in memory 33;

—maximum number of probe contacts (test points) 189.

The diagnostic unit PS-1467 operates in the following modes: automatic, single-action, stepped or manual.

The automatic mode is the basic operation regime for testing printed circuits. The remaining modes serve an auxiliary function. When operating automatically, the tester carries out a measurement program kept in its memory. In the single-action mode, the tester measures only one element, indicated by a number entered by the operator. In the stepped mode the tester measures the elements consecutively, starting from an element indicated by the operator. In manual operation mode, the equipment carries out a measurement cycle according to a program entered into the memory of the diagnostic stand.

ND-1481 Nonuniformity Measurement Unit

The ND-1481 equipment measures the nonuniformity in the movement of a medium and the deviation of its speed from the standard in all sorts of cassette recording and phonograph equipment, including professional equipment used in recording studios. In addition, the unit measures frequencies up to 100 kHz. The measured quantities are read out in analog-digital mode.

The operation principle of the unit is conversion of the input signal frequency to voltage. The difference between the input signal frequency and the reference frequency of 3150 Hz is shown on the digital display, indicating the deviation of the speed of the medium. The half-value of the interpeak frequency fluctuation of the input signal is displayed on the screen as the measure of nonuniformity of the speed.

The unit has the following main features:

—input parameters: voltage 10 mv - 10 V; frequency: a) 3150 Hz ± 20 percent, b) 10 Hz - 100 kHz; input impedance 315 kΩ;

—analog measurement of nonuniformity in range from 0.03 to 3 percent;

—digital measurement of the speed deviation in the range from ±0.001 to ±9.999 percent; measurement time 0.3 s, 3 s or 30 s;

—frequency measurement in the range of 10 Hz to 99.99 kHz.

Cassette Recording Machine RK-1531

The cassette recording machine RK-1531 is intended for control of telephone communication at medical and technical or fire emergency stations, airport traffic control stations and wherever conversations have to be registered for control purposes. Standard cassette recorders can be used to play back the recorded information.

The RK-1531 recording unit consists of a power block, control block, electronics block and two panels with cassette recording mechanisms (cassette types C60 and C90). The control block converts the telephone exchange signals so that at the time of connection with the caller the electronics block switches on automatically the recording mechanism and turns it off when the telephone line is disconnected. In case of a failure of the recording mechanism, the electronics block activates the second reserve tape recorder.

The basic features of the recording unit are: tape speed 4.76 cm/s; variations in tape speed not greater than 0.5 percent; speed deviations ±2 percent; starting time 1.2 s for telephone input of 100 mV - 4 V; frequency band 200-4000 Hz for tape recorder input of 10 mV; frequency range 80-6500 Hz; automatic control of recording 32 dB; transition signal between channels 25 dB; dynamics 45 dB.

- Metronex Foreign Trade Enterprise

Metronex has presented a large and interesting exposition. Special attention was attracted by the following novelties in the area of electronic measurement equipment and computer technology.

Signal Generator PG-20

The PG-20 signal generator, manufactured by Zopan Enterprises in Warsaw, is a piece of laboratory equipment that serves as a source of sinusoidal voltage in a frequency range of 50 Hz to 102.4 MHz, selected in 11 subranges and adjusted continuously in each subrange with a high precision (frequency control accuracy of 0.005 percent). The frequency is regulated automatically with the aid of a six-digit counter. The output voltage, regulated in a range of 1 μV to 1 V, can be amplitude- or frequency-modulated (internal modulation by frequencies of 400 Hz, 1 kHz and 4 kHz). The PG-20 generator is intended for research and production of electronic equipment (including radio receivers). When combined with an oscilloscope, the generator can be used to observe the resonance curves of systems being tested.

Functional Generator KZ-1405

The functional generator KZ-1405, manufactured by Zopan Enterprises in Warsaw, is a state-of-the-art source of sinusoidal, triangular and rectangular signals in the frequency range of 0.01 Hz to 10 MHz. The generator regulates the symmetry of the patterns in the range from 20:80 to 80:20. This, in turn, makes it possible to obtain linearly rising processes with the ratio of the time of the rising slope to the declining slope, or a rectangular pattern with a variable shape. The generator has three operation modes: normal, switched and gated. The amplitude of output processes is U_{pp} = 20 V (open output) and U_{pp} = 10 V (under load of 50 ohms). The regulated reference level is the area of ±10 V; the damper is -20 dB and -40 dB; the output resistance is 50 ohms.

The generator KZ-1405 is intended for use in research and teaching, as well as in the industry.

An advanced version of the KZ-1405 generator is a new functional generator (POF-10 wobbulator), where the upper frequency has been raised to 12 MHz and a different type of internal wobbulator has been used to modify the frequency of the basic generator. The production of this unit will begin in 1985.

Digital Frequency-Time Measurement Units KZ-2025 and KZ-2026

The KZ-2025A, B and C and KZ-2025A, B and C digital frequency-time measurement units produced by Zopan Enterprises in Warsaw are multifunctional instruments that can be used to measure the following: frequency, range, medium range, time limits, duration of a pulse and the frequency ratio. They can also be used as a pulse counter or a source of reference frequencies. The KZ-2025 and KZ-2026 differ solely in the digital indicator: the former has a Nixie 15 mm indicator and the latter a seven-segment LED 15 mm indicator. The technical parameters are: frequency range 0-80 MHz; time resolution 100 ns; resolution of the measurement of medium time 1 ps; reference frequencies 1 Hz, 10 Hz, ..., 10 MHz; BCD output (optional).

The next issue of ELEKTRONIKA (1985, No 7) will carry an article by J. Zelichowski entitled "Control and measurement electronic equipment produced by Zopan Enterprises for Development and Production of Scientific Equipment," which will give detailed information on the full line of products available from this manufacturer.

D-180 Printer

The D-180 printer, developed and produced by Mera-Blonie Enterprises, is a mosaic miniprinter controlled by a microprocessor and intended for computer terminals and microcomputers. The paper transport mechanism and the printing mechanism allow the printing of the complete set of 96 characters of ASCII and a complete set of KOI-7 with a speed of 180 characters per second. The printer accommodates original with four copies on a continuous side-perforated paper tape. Paper width ranges from 4 to 17 inches; maximum thickness 0.6 mm. Printing method is serial impact mosaic; printing speed 50 to 40 lines/min; unidirectional printing; 132 or 158 characters per line; matrix 9 x 7 points; character size: height 3.45 mm, width 2.1 mm or 1.81 mm. The printer is equipped with interfaces compatible with most minicomputers. Standard interface: eight-bit Logabax logic, levels TTL, buffer 256 characters, maximum data reception speed 8000 characters/s; optional interfaces: IRPR (SM EMC), V24 (S2), IEEE 488 (IEC 625) and Centronics.

Mera-Camac-1300 Minicomputer System

This system is developed by the Institute of Mathematical Machines in Warsaw and manufactured by ERA Factory of Measurement Instruments and Computers in Warsaw.

The Mera-Camac-1300 system is a 16-bit computer based on two international standards: the standard of the Small Digital Electronics Machines System (SM EMC) compatible with the minicomputer family PDP-11 produced by DEC, and the Camac standard that unifies the measurement and control components. The system incorporates the Soviet-made SM-1300 processor based on the VLIS circuits (segmental microprocessors, programmed control matrices and ROM and RAM memories).

The Mera-Camac-1300 system can be used in areas where limitations of the working memories (28 kilowords) present no major obstacle. The system can be used in the following:

—automated measurement and control systems for research purposes;

—remote and local intelligent interfaces;

—automated workplaces for engineers in development, process control and design;

—simple monitoring systems in the control of industrial processes;

—training in programming skills at the basic level for secondary vocational schools or for college students other than those majoring in computer science.

RTDS-8 System

The RTDS-8 system (acronym for Real Time Development System for eight-bit microprocessors) is an auxiliary piece of equipment for design and development of microcomputers based on emulators and disk operation systems. The RTDS-8 is produced by Mera-Elzab Computer Enterprises in Zabrze, jointly with the Laboratory of Computer Automation Systems of the Polish Academy of Sciences in Gliwice.

A problem confronted in building and testing application systems with microprocessors and the related software has made it necessary to develop specialized hardware and software known as auxiliary systems. The RTDS-8 belongs in this category. It is a modular system helpful in the development of software and integration of hardware and software in creating a microcomputer on the basis of a universal system emulator of eight-bit microcomputers.

- Labimex Foreign Trade Enterprise

The exposition of laboratory and measurement equipment presented by Labimex included, in addition to older products, several innovations. The most important of these was certainly the MD-12 defectograph, which was awarded a gold medal (as described at the beginning of this article).

Among other novelties, one should mention the following: the MJ-111 magnetometer, the industrial temperature measurement units 57, 58 and 59, and varipipettes 3000.

MJ-111 Mangetometer

The MJ-111 magnetometer, developed and produced by Radiopan Enterprise of the Polish Academy of Sciences in Poznan, serves for precision automatic measurements of the intensity of homogeneous magnetic fields. The unit operates on the basis of nuclear magnetic resonance. The MJ-111 magnetometer has two measurement heads: the MH1 for the range of 0.15-1.5 teslas and of the type MH2 for the range of 0.05-0.35 teslas. The measurement

result is displayed in teslas on a seven-segment LED indicator. The measurement divisions are 10^{-6} teslas, and the modulation frequency of the magnetic field is 260 Hz. The MJ-111 magnetometer is intended for applications in EPR and MNR spectroscopy, in equipment for testing the magnetic properties of materials, in a static homogeneous magnetic field, for calibration of magnetic fields and also as a reference unit for calibration of magnetic field testers operating on different principles.

Temperature Measurement Units 57, 58 and 59

The noncontact temperature measurement units 57, 58 and 59 are manufactured by Wilmer, the Microwave Equipment Laboratory of the Polish Academy of Sciences in Warsaw. The instruments measure temperature in industrial conditions wherever contact methods cannot be applied. Thanks to a small required surface area whose temperature can be measured, the equipment can be used to monitor the temperature of relatively small objects. The instruments can be combined with automatic systems.

Each unit consists of a converter with an optical collimator placed on a holder and a readout block. The two are linked by a cable.

The basic parameters are as follows:

--range of temperature measured: type 57 200-600°C, type 58 400-1000°C, type 59 800-1800°C;

--the measured surface increasing with the distance from the converter: diameter 10-110 mm, distance $l = 1.5$-4 m;

--emission factor of surfaces tested 0.05-1;

--resolution 1°C;

--measurement accuracy 1 percent of value measured;

--spectral range 0.7-3 μm;

--readout of results: analog in 57-1, 58-1 and 59-1; digital in 57-2, 58-2 and 59-2;

--cable length: standard 5 m, optional up to 100 m.

Varipipettes 3000

The Polish-Austrian firm Plastomed (Warsaw) exhibited a diverse mix of products made from a high-purity synthetic group of materials (polystyrene, polypropylene and polyethylene), including bottles, glasses and pipettes. The products are mainly intended for medical laboratories and clinics. There is a demand for such products, however, also in the technology of electronic materials, especially in organizations concerned with the production and analysis of semiconductor materials.

One interesting product is the varipette 3000, intended for precision dosage of fluids. It is available in three versions, corresponding to three ranges of dispensed substance: 2-20 μl, 20-200 μl and 200-1000 μl. The desired capacity is set on a three-digit indicator in the handle of the pipette. The accuracy of dosage depends on the volume of the dispensed material and ranges from $\leqslant$0.2 percent for 1000 μl to $\leqslant$4 percent for 2 μl.

The next issue of ELEKTRONIKA (1985, No 7) will publish the second part of this report, which describes other interesting innovations in the field of electronics exhibited at the 26th International Fair in Brno.

9922
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VIBRATION-PROOF DEVICES USED IN MINING INDUSTRY

Bucharest MINE, PETROL SI GAZE in Romanian No 9, Vol 36 Sep 85 pp 443-446

[Article by I. N. Constantinescu and Al. Darabont: "Controlling Vibration in Machinery and Equipment Used in the Mining Industry"]

[Text] General

The rapid development of technology has resulted in constant increase in machine operating speeds and decrease in machine weight per unit power. This development has been accompanied by intensification of the negative effect of vibration on man and on the buildings involved, something which has made it necessary to take steps to limit or eliminate the harmful effects of vibration.

Vibration-Damping Machinery and Equipment

The machine shops of mining enterprises and coal or ore dressing enterprises have a variety of machinery and equipment which generate vibration. This machinery and equipment may be installed by rigid attachment to a foundation or may be supported by vibration-damping elements.

When machines are installed by rigid attachment to a foundation, the vibrations generated during machine operation are transmitted to the structure of the building, with the attendant negative effects both on the buildings and and on persons working in the vicinity of the source of vibration.

In some developed countries there has recently been a large-scale shift to mounting machines on vibration-damping elements directly on the building floor, with no mounting base. Such installation offers a number of advantages:

It simplifies the operation of installing machines, since the need for using costly mounting bases is eliminated.

It permits simple and rapid repositioning of machines if the production process is modified.

It ensures efficient shielding of persons and buildings from vibration.

It can be carried out where the use of special mounting bases is not feasible (for machines to be installed on floors in the upper stories of buildings).

Rubber is used in many situations to produce vibration-damping elements. This substance possesses a number of vibration-damping properties, including the following.

The compressive modulus of elasticity is very small. Rubber undergoes considerable deformation while retaining the ability to absorb by impact mechanical work 4 times greater than that absorbed by steel springs.

The elastic constants are small, so that the natural vibration of machines resting on rubber is the lowest that can occur.

Because of the damping properties indicated, 30 to 35 percent of the total vibration energy can be dissipated.

In comparison to other materials, rubber occupies less space at the same efficiency. It is light in weight and may also be used in conjunction with steel springs.

Along with these properties, rubber also exhibits certain disadvantages when used to produce vibration-damping elements.

It loses its elastic properties under the influence of atmospheric agents, and especially of various chemical agents with which it may come in contact (oils, acids).

Over a period of time ranging from 4 to 6 years, aging occurs in rubber. The rubber loses its elastic properties and begins to crack, jeopardizing the suspension system.

Vibration-damping elements in which rubber is replaced by a Romanian polyurethane, Moldotan, have been developed and tested in recent years as a result of research conducted at the Labor Safety Scientific Research Institute in Bucharest, in cooperation with staff instructors of the Institute of Mines in Petrosani and research workers at the Petru Poni Institute of Macromolecular Chemistry in Iasi.

The polyurethane Moldotan retains all the advantages of rubber and adds new ones of its own, including the following.

It retains its elastic properties when subjected to the action of chemical agents. This is a highly important property in machinebuilding, where vibration-damping elements are saturated with oils, and in the chemical industry, where they may be exposed to acids or bases.

The elastic properties of the polyurethane, unlike those of rubber, are retained over a virtually unlimited period of time, so that there is no need for replacement.

The molds used for casting pieces of Moldotan are much simpler and cheaper than the dies used for vulcanizing pieces of rubber.

Considering the advantages of vibration-damping elements made of Moldotan, such elements have been produced and tested initially with various machine-tools such as lathes, milling cutters, and grinding machines.

The tests conducted at various enterprises have confirmed the advantages of these vibration-damping elements in comparison to those of rubber, so that conditions now exist for starting up serial production.

Vibration-damping of Compressed-Air Striking Tools

Light blast hole drilling equipment represents a significant source of vibration in the mining industry. It is made up of a drill hammer and compressed-air drill column.

The main source of vibration in such equipment is represented by the compressed-air motor with free-floating drill piston. Drill vibration and recoil occur along the axis of the drill and part of them are transmitted to the hand of the worker operating the equipment.

The vibration characteristic has been found to exceed the limit permitted by labor safety standards in all modern drills. Intensive work is accordingly underway at many research institutes and plant laboratories to find the most efficient solutions for reducing the harmful effects of recoil and vibration on the human organism.

The following methods may be applied to control drill recoil and vibration: use of individual protection equipment, such as vibration-damping gloves; development of a drill with a vibration-damping handle; drilling under optimum conditions; and suitable modification of the processes which take place in the distribution element and the motor cylinder of the drill.

The following discussion will be devoted to the solution represented by vibration insulation of the drill from the handle or use of vibration-damping handles.

The force of advance of the drill column is transmitted to the drill by way of the housing and a spring. The handle and pressure regulator with which the worker comes in contact in the drilling process are thus insulated from vibration.

Several models of vibration-damping handles for P-90 drills were developed and tested underground over the 1980-1982 period, among which we may mention two Compas metal models with rubber joints and two models made with Romanian Moldotan polyurethane.

The best results were obtained with a one-piece model of annular polyurethane attached to a drill by simple screw attachment.

To test the reliability of these handles under very severe underground conditions, more than 2000 drills were outfitted with the handles in 1982 and 1983, many of them at the Balan Mining Enterprise. These tests showed that the handles are reliable and possess a high ability to dampen vibration.

Endurance testing was accompanied by comparative measurements of the vibration level of an original rigid metal handle and of an elastic handle of Moldotan.

These measurements point to the following conclusions.

The Moldotan handle lowers the acceleration level at a frequency of 8 Hz from 230 to 20 m/s^2, the damping being 22 db.

The best vibration level damping is achieved in the frequency ranges of 8 to 25 Hz and 63 to 800 Hz, the damping values ranging from 4 to 22 db.

Another category of compressed-air striking tool whose vibration level exceeds the limits permitted by standards in force is that of mechanical picks, chisel hammers, and rough working hammers used underground, in foundries, and in metal construction operations.

To lower the vibration level in hammers of these types, a number of models of vibration-damping handles have been developed in various countries. They all have metal springs as the elastic elements. These handles are of complicated design and are breakdown-prone, and for this reason their use is limited.

Considering the good ability of Moldotan polyurethane to dampen vibration, this material has been used to make vibration-damping handles for the CD-4 and CD-6 rough working and chisel hammers. The polyurethane vibration-damping handles have been produced by casting in special molds, some of the metal components of the handle being embedded in the bulk of the polyurethane. The initial shape of the handle has been retained in the polyurethane model.

Endurance testing conducted at a mining machinebuilding enterprise has shown that the dependability of these handles and their ability to lower the vibration level are good.

The endurance testing was paralleled by measurements made to determine the vibration level damping ability. An original rigid handle and a Moldotan handle were accordingly mounted in succession on the same hammer.

Findings

The foregoing considerations point to a number of conclusions, which are listed below.

Some items of machinery and equipment used in the mining industry generate vibration levels which can exert a negative effect on man, machines, and the buildings involved.

To eliminate, or at least limit, the harmful effects of these vibrations, provision must be made for mounting these machines and equipment on vibration-damping devices, in which the elastic element of rubber can be replaced by polyurethane of the Moldotan type.

The vibration levels generated by a number of compressed-air striking tools used in the mining industry and mining machinebuilding industry exceed the limits permitted by the standards.

The level of vibration transmitted to the worker's hand can be lowered substantially by use of vibration-damping handles of Moldotan for P-90 drills and for compressed-air hammers.

In view of the good results obtained at the Balan Mining Enterprise over the 1982-1985 period by outfitting P-90 drills with Moldotan vibration-damping handles, use of these handles should be extended to all the mining enterprises in the country.

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6115
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